

## SYSTEMATICS, BEHAVIOR & BIONOMICS OF COSTA RICAN KATYDIDS OF THE GENUS *SPHYROMETOPA* (ORTHOPTERA: TETTIGONIIDAE: AGROECIINAE)

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**ABSTRACT:** Katydids of the genus *Sphyrometopa* are aberrant members of the Agroeciinae. They are found in primary growth forests in low population numbers which increase when windfalls or man's activity create openings in the forest providing herbaceous secondary growth. Nymphs are green and live in low, green herbaceous growth and move to the dry leaves of primary forests at maturity. Two species are known: one from the mountains of central Costa Rica, the other from the Atlantic lowlands of that same country.

**DESCRIPTORS:** behavior; distribution; karyotype Agroeciinae

Katydids of the genus *Sphyrometopa* Carl occur in primary and secondary forest habitats in central and eastern Costa Rica. The systematic position of the genus has been unclear and the bionomics of the species unreported in the literature. The author's numerous visits to Costa Rica have provided the opportunity to study the species of *Sphyrometopa* and provide observations on their life history strategies. In this paper I present a clarification of the genus, redescription of species and observations on the biology and bionomics of species.

### TAXONOMIC HISTORY

*Sphyrometopa* was proposed by Carl in his 1908 revision of the conocephalids in the Geneva Museum. He included a single species, *S. femorata* Carl, and was unaware that Rehn (1905) had described the same species but had placed it in the genus *Conocephalus*. Both species were described from single females. Later Karny (1912) in his Genera Insectorum section on the Copiphorinae listed both names separately and included Carl's original figures. He too was unaware of the synonymic nature of the two names.

The subfamilial placement of *Sphyrometopa* is not entirely clearcut. *Sphyrometopa* species bear characters making them difficult to place in any

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<sup>1</sup> Accepted for publication: March 9, 1976

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subfamily with confidence. They show relationships with both the Copiphorinae and Agroeciinae. Rehn (1905) placed his species in the Conocephalinae. Hebard (1927) noted that *Sphyrometopa* as well as several other tropical American genera were aberrant members of the Agroeciinae. Walker and Gurney (1972) presented a table listing characters which can be used to distinguish agroeciines from copiphorines. On the basis of these characters, *Sphyrometopa* shows more relationship with the agroeciines than with the copiphorines. The characters placing them in the Agroeciinae include: vertex separated from frons by a thin sulcus; no trace of tooth on vertex; ovipositor curved, not straight. The usual character distinctive of the subfamily is the narrow fastigium. This is not found in *Sphyrometopa*. Instead, the fastigium is very broad which is similar to the usual state found in the Copiphorinae. Related tropical American genera here considered as aberrant Agroeciinae and possessing broader than average fastigia are: *Uchuca* Giglio-Tos, *Eppia* Stal, and *Dectinomima* Caudell.

### BIONOMICS

*Sphyrometopa* species live in primary growth forests. They secondarily move to clearings and forest openings of early secondary growth as the opportunity arises. One of the species herein described occurs in the Atlantic Lowland Tropical Forest, the other from the Lower Montane altitudinal belt of the Cordillera de Tilaran and south of the western edge of the Cordillera Central. Both species are more abundant in the early herbaceous secondary growth adjacent to primary forests. These katydids, like many acridomorphid grasshoppers found in new secondary growth, move out of the forest and into such situations as a result of natural catastrophe such as tree falls. Certain human-associated intrusions into the forests such as paths or roads also provide suitable habitats for these insects. However, they are restricted to small clearings or marginal areas and are absent from larger clearings such as open fields because of the need of the flightless adults to return to primary forest upon maturity. *Sphyrometopa* populations reach their highest levels in small clearings or along paths where suitable amounts of sunlight can penetrate to permit growth of herbaceous flora. Upon the return of such areas to climax-type vegetation with a predominance of shade, the *Sphyrometopa* populations dwindle.

### BIOLOGY

*Sphyrometopa* species undergo at least five nymphal instars. The nymphs of the first three stages are lime green, occasionally with a few black speckles



Figure 1. *Sphyrometopa femorata* Carl. Adult male, Monte Verde, Costa Rica.



Figure 2. *S. atlantica* Rentz. Second or third instar nymph, Finca La Selva, Costa Rica.

(see fig. 2). The fourth instar bears a trace of green and is yellowish brown. Fifth instars are much darker and have lost all green coloration. The faces of young nymphs are green, the brown appearing in fourth instar.

The difference in nymphal coloration reflects a different life style between nymphs and adults. The young nymphs occur in green vegetation, usually dense grasses and herbs. They are frequently found in the vegetation a foot or so from the ground. Although never found far from the forest, the nymphs seem to venture farther into secondary growth areas than do adults. Last instar nymphs are more associated with leaf litter and tend to live closer to the primary forest. Adults occur on the ground at the margin of the primary forest usually in leaf litter or associated vegetative debris where they remain secluded and quiet during the day. At night they climb onto vegetation where they sing and feed. Some adults remain deep within primary forests and live within the sheltered buttresses of large trees.

#### *Sphyrometopa* Carl

1908. *Sphyrometopa* Carl, Revue Suisse de Zoologie, Annales, 16 (2): 134-135.

Generic description. — HEAD with fastigium of vertex broad, 3-4 times as broad as first antennal segment; surface of fastigium minutely rugulose. Eye round, situated high on head. Frons smooth, flat. First antennal segment produced on dorso-internal margin, flagellum annulate. PRONOTUM dorsally finely rugulose, with a thin median carina; lateral lobes moderately deep, humeral sinus well indicated, thin but persistent transverse sulcus present in anterior portion of disk of aciculate spines. TEGMINA and WINGS well developed, never extending to apex of abdomen, incapable of flight. LEGS: Fore and middle femora wholly unarmed, hind femur with a number of teeth on both margins of ventral surface; genicular lobe of hind femur with a prominent tooth on internal margin. Fore and middle tibiae unarmed dorsally. Hind tibia armed dorsally with a single pair of apical spurs, ventrally with 2 pairs of spurs. ABDOMEN without distinctive median carina, apical portion of each tergite raised, pinched; cercus complex, apical tooth prolonged, thin; basal portion with a prominent internal knob. Titillators paired, flat, with a pair of accessory sclerites. FEMALE with tenth tergite excised medially. Ovipositor short, sickle-shaped, distinctly upturned usually dark brown in color. Subgenital plate simple, medially excised. COLORATION: Face with a large circular dark brown, almost black, polished patch encompassing two-thirds of face; adult dark brown and grey, frequently with a broad, dorsal yellow-brown longitudinal stripe (fig. 1). Legs mottled brown, outer pagina of hind femur dark brown on entire ventral half, this area bounded dorsally by a lighter creamish stripe. Nymphs: first four instars light lime green, fifth instar straw brown, rarely an overcast of green; legs, pronotum, sides of abdomen darker (see fig. 2).

#### *Sphyrometopa femorata* Carl

(figures 1, 3-7, 15, 17, 18, map 1)

1908. *Sphyrometopa femorata* Carl. Revue Suisse de Zoologie, 16 (2): 135, plate 4,



Map. 1. Known distribution of *Sphyrometopa* species in Costa Rica.

figs. 6,7. Type locality: "Costa Rica." Holotype female in the Museum d'Histoire Naturelle, Geneva, Switzerland.

1912. *Homorocoryphus rehni* Karny, 1912, *Genera Insectorum*, 139:37, New name for *Conocephalus diversus* Rehn, 1905, *Proceedings of the Academy of Natural Sciences of Philadelphia*, p. 825-826, figs. 14, 15. Holotype female: "Guatel, Costa Rica. C.F. Underwood collector." Holotype in Academy of Natural Sciences of Philadelphia. New synonymy.

This species was described twice, first by Rehn (1905), then three years later by Carl. Rehn's name was found to be a primary homonym and was replaced by Karny (1912). Coincidentally both Rehn's and Carl's species are synonyms although Karny did not detect this even though the generic names were both within the scope of his work and both species were illustrated by their respective authors.

This author has examined the types of both species. There is no question concerning the synonymy of the two. Unfortunately, the precise type

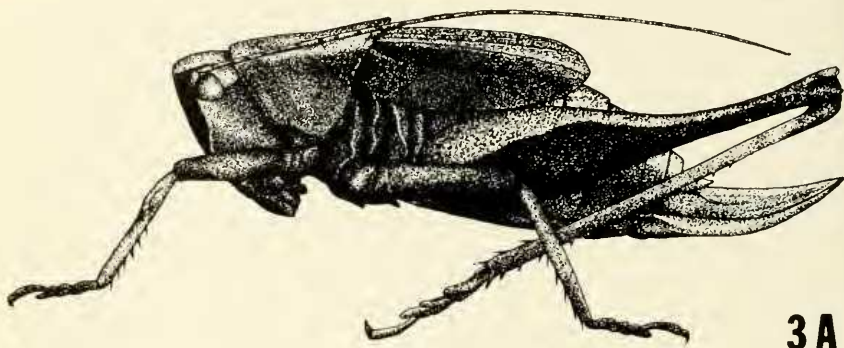


Figure 3A. Holotype, *Conocephalus diversus* Rehn (= *Sphyrometopa femorata* Carl). Original from Rehn (1905).

localities for either have not been located but they must have been collected in central Costa Rica, probably south of San José. The type of *S. femorata* is considerably larger than that of *C. diversus*. It approaches *S. atlantica* in this respect (tables 1, 2). But the reduction of rugulosity of the pronotum and shape of the subgenital plate and the truncate tegmina serve to separate it from *S. atlantica*. The type of *C. diversus* is much smaller, similar in size to the populations from Monte Verde.

Mention of *Sphyrometopa* species in the literature was made by Hebard (1927) in his studies on the Panamanian Tettigoniidae. Although he did not record the genus from that country, he discussed its relationships with *Eppia* Stal, *Uchuca* Giglio-Tos, and *Dectinomima* Caudell. Males of *S. femorata* have never been described and the habits of the species are unreported until now.

Diagnosis. — Size small for genus (fig. 1). Pronotum relatively smooth, faintly granulate; fastigium of vertex (fig. 1) relatively narrow; apex of tegmina truncate. Males with internal "toe" of cercus with proximal angle acute (fig. 4); titillator with apex truncate (fig. 5). Females with subgenital plate with lateral angles acute (figs. 17, 18), unmodified. Known from central Costa Rica.

Species description. — PLESIOTYPE MALE. COSTA RICA: PUNTARENAS PROVINCE: Monte Verde Cloud Forest Reserve, near Powell house, 23 March 1974. D.C. Rentz collector. Plesiotype deposited in Academy of Natural Sciences of Philadelphia. Size small, form slender. PRONOTUM dorsally finely rugulose; anterior margin truncate; lateral lobes shallow, broad transverse sulcus thin, but well defined on anterior 1/3 of disk. TEGMINA and wings present, the latter much less developed than in *S. atlantica*, *in situ* attaining 6th or 7th tergite; apex of tegmen broad, not lanceolate,



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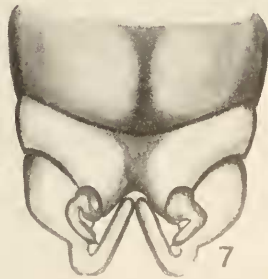
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Figures 3-7. Diagnostic characters in males of *Sphyrmetopa femorata*. Fig. 3, adult male, 7x; fig. 4, right cercus, dorsal view; fig. 5, titillators; fig. 6, subgenital plate, ventral view; fig. 7, apex of abdomen, dorsal view.

stridulatory area well developed. LEGS: hind femur bearing a number of stout teeth on both margins of ventral surface. Fore and middle tibiae armed on ventral surface with 6 spines on anterior margin, 4 on posterior; middle tibia armed on ventral surface with 5 spines on anterior margin, 4 on posterior; hind tibia with 15 spines on both margins of dorsal surface, ventral surface unarmed except at apex. Apex of hind tibia with a single pair of apical spurs of equal length on dorsal surface; ventral surface with two pairs of apical spurs and a pair of subapical spines preceded by a single spine on outer margin which is in turn preceded by a pair of spines. ABDOMEN: tenth tergite, titillator and subgenital plate as in figs. 4-7). COLORATION: overall ground color a mixture of dark browns, face very dark brown, almost black; vertex and pronotal disk mottled grey brown; legs as in *S. atlantica*.

Redescription of holotype female. — Size large for species, form robust. PRONOTUM dorsally finely rugulose, median carina indicated mostly by color; anterior margin of disk obtuse, posterior margin truncate; lateral lobes deep, concave in region of coxa; humeral sinus well indicated; transverse sulcus of disk deep, well indicated in anterior quarter. TEGMINA and wings attaining middle of sixth segment, tegmen with apex truncate. LEGS: tibiae and femora armed as in male. ABDOMEN: tenth tergite deeply incised, apices produced as in fig. 15; cercus broad in basal two-thirds, apex narrowed; subgenital plate with apex relatively broad; ovipositor relatively narrow, not as greatly upturned as in *S. atlantica* (fig. 13). COLORATION precisely as described for male.

Records. — COSTA RICA: CARTAGO PROVINCE: Cachi, Rio Reventazon, March 1902, 1100 meters elevation, (P. Biolley, 1♀, ANSP). Monte Verde, Pension, 1500 meters elevation, 22, 23 July 1973, 24 March 1974 (D.C. Rentz, K.R. Brodey, 7♂♂, 7♀♀, DCR); Powell property, 1580 meters elevation, 23 March 1974 (D.C. Rentz, 1♂, CDR). Navarro, 24 July 1929, 1160 – 1190 meters elevation, (C.H. Lankester and J. Rehn, 1♀, ANSP). Uncertain geographic placement in Costa Rica: El Muneco, 20 June 1928, 1430 meters elevation, (F.G. Wallace, 1♀, ANSP. Uncertain province: La Palma, between Volcan Irazu and Volcan Barba, 28, 30 July 1927, 1520 meters elevation (J.F. Tristan and J. Rehn, 1♀, 1 last instar ♀, ANSP).

Discussion. — *S. femorata* occurs in two different habitats at Monte Verde, Tilarán Mountains. It is present in the Monte Verde Reserve but in low population numbers. It appears to be more abundant at a slightly lower elevation in the region of the Pension where it could be considered as abundant in the gardens and edge of the forest. This reflects the abundance-distribution pattern described for *S. atlantica*.

The Monte Verde locality lies within the Lower Montane altitudinal belt of Holdridge (1967). It is a very different climatic regime from that encountered at Finca La Selva. But apparently certain genera share species between the two localities. (See Rentz, 1975, for discussion of the two habitats with reference to climate and vegetation.



Table 1. Measurements (in mm) of *S. femorata*

	Length Body	Pronotum Length	Width	Length Exposed Tegmen	Length Hind Femur	Ovipositor
<b>Males</b>						
plesiotype	23.5	7.6	4.7	10.0	17.1	
Monte Verde	22.0	7.4	4.5	9.0	18.5	
Monte Verde	21.5	7.6	4.9	11.3	17.9	
Monte Verde	21.5	7.1	4.5	9.8	17.7	
Monte Verde	24.5	7.3	4.3	10.2	18.1	
<b>Females</b>						
Monte Verde	22.0	7.2	4.3	9.3	18.8	8.7
Monte Verde	23.0	7.3	4.3	9.0	18.8	8.9
Monte Verde	23.5	6.6	4.2	8.1	17.3	8.6
Monte Verde	22.5	7.4	4.5	8.7	20.2	9.6
Monte Verde	22.5	7.0	4.3	8.0	18.0	9.0
Monte Verde	23.5	7.2	4.5	8.5	18.8	8.5
Monte Verde	22.0	7.1	4.3	8.0	17.8	8.6
holotype <i>C. diversus</i>	21.0	7.3	4.7	8.6	19.2	9.0
El Muneco	18.5	7.6	4.6	9.0	20.0	8.3
La Palma	23.0	8.1	4.7	8.8	20.0	9.0
Cachi	21.0	7.5	4.5	8.7	19.1	8.8
Navarro	23.5	7.8	4.7	8.9	19.5	8.8
holotype <i>S. femorata</i>	26.0	8.7	4.8	9.5	22.0	8.2

***Sphyrometopa atlantica* Rentz, new species**

(Figures 2, 8-12, 13, 14, 16 Map 1)

Diagnosis. — Size large for genus. Pronotum distinctly punctate, rugulose; fastigium of vertex broad (fig. 8); apex of tegmina lanceolate. Males with internal "toe" of cercus with proximal angle rounded (fig. 10), ventral surface with tooth (fig. 10A); titillator with apex rounded (fig. 11). Females with subgenital plate with lateral angles hooked (fig. 16). Known from the Atlantic drainage of Costa Rica.

Description. — HOLOTYPE MALE. COSTA RICA: HEREDIA PROVINCE.

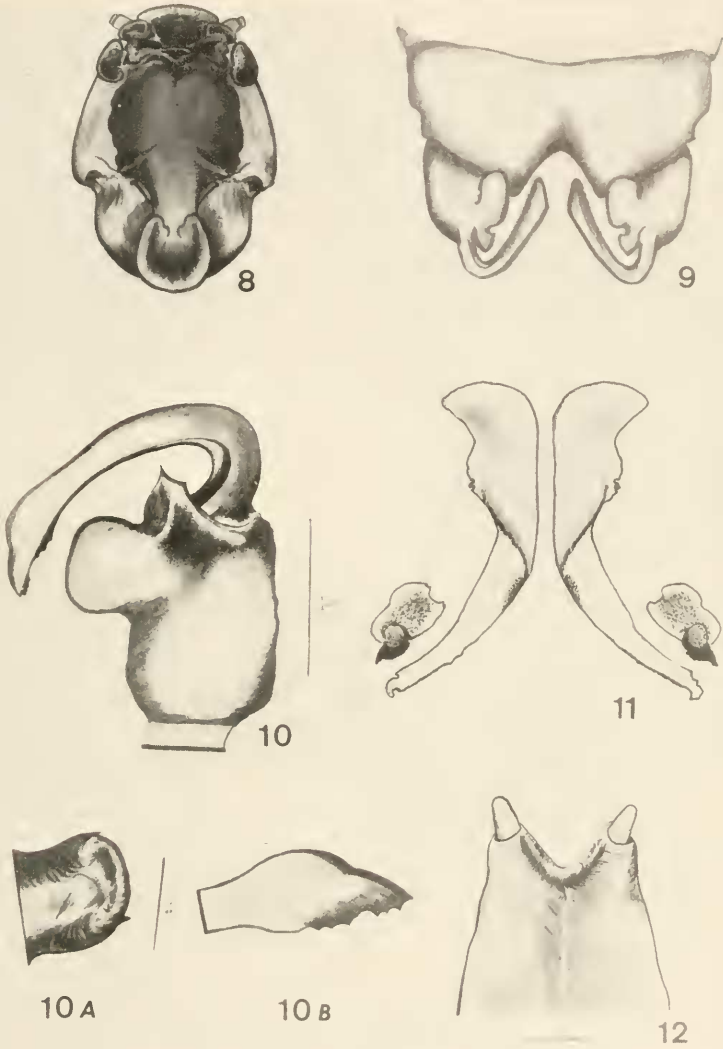
Puerto Viejo, Finca La Selva, 13-16-VIII-1973. D.C. Rentz, K.R. Brodey collectors. In arboretum II. Holotype and allotype are deposited in the Academy of Natural Sciences of Philadelphia. Size large for genus, form stout, robust. HEAD with fastigium of vertex very broad, four times as broad as first antennal segment; frons rather smooth, flat; first antennal segment produced on dorso-internal margin. PRONOTUM dorsally finely rugulose, with fine median carina; anterior margin weakly concave, distal margin truncate; lateral lobes deep, concave in region of coxa; humeral sinus well indicated, thin but persistent transverse sulcus present in anterior portion of disk. TEGMINA and wings extending to base of ninth or tenth tergite in life; tegmen lanceolate, apex acute, stridulatory area well developed. LEGS: fore and middle tibiae armed ventrally with 6 spines on anterior margin, 4 on posterior; hind tibia armed with 17 spines on internal margin and external margins of ventral surface wholly unarmed except apically. Apex of hind tibia armed dorsally with a pair of apical spurs of equal lengths; ventral surface bearing 2 pairs of apical spurs of equal lengths; a pair of subapical spines and a single presubapical spine on outer margin. ABDOMEN: tenth tergite, cercus, titillator, and subgenital plate as in figs. 9-12. COLORATION: overall ground color a mixture of dark browns; face, in region bounded by eyes (fig. 8) dark brown or blackish, bounded externally by a light creamish area, dark area extending onto clypeus a labrum; vertex and disk of pronotum mottled grey brown; fore and middle tibiae light brown with a trace of a subapical and subbasal darker annulus; fore and middle femora dark brown externally, internal (anterior) face mottled grey; hind tibia dark brown, not black, femur dark brown or blackish in ventral half, especially basally, apical half and dorsal half of femur lighter brown; tarsi dark brown with apical pad black. Abdomen darker brown laterally, dorsum light brown, ventral surface dark black; cercus and subgenital plate light brown.

ALLOTYPE FEMALE. Same data as holotype. Similar to male but with following exceptions: size larger, form more robust. Tenth tergite, cercus, and subgenital plate (figs. 13, 14, 16). Ovipositor short, sickle-shaped, distinctly upturned (figs. 13, 14). Coloration similar, ovipositor uniformly dark brown.

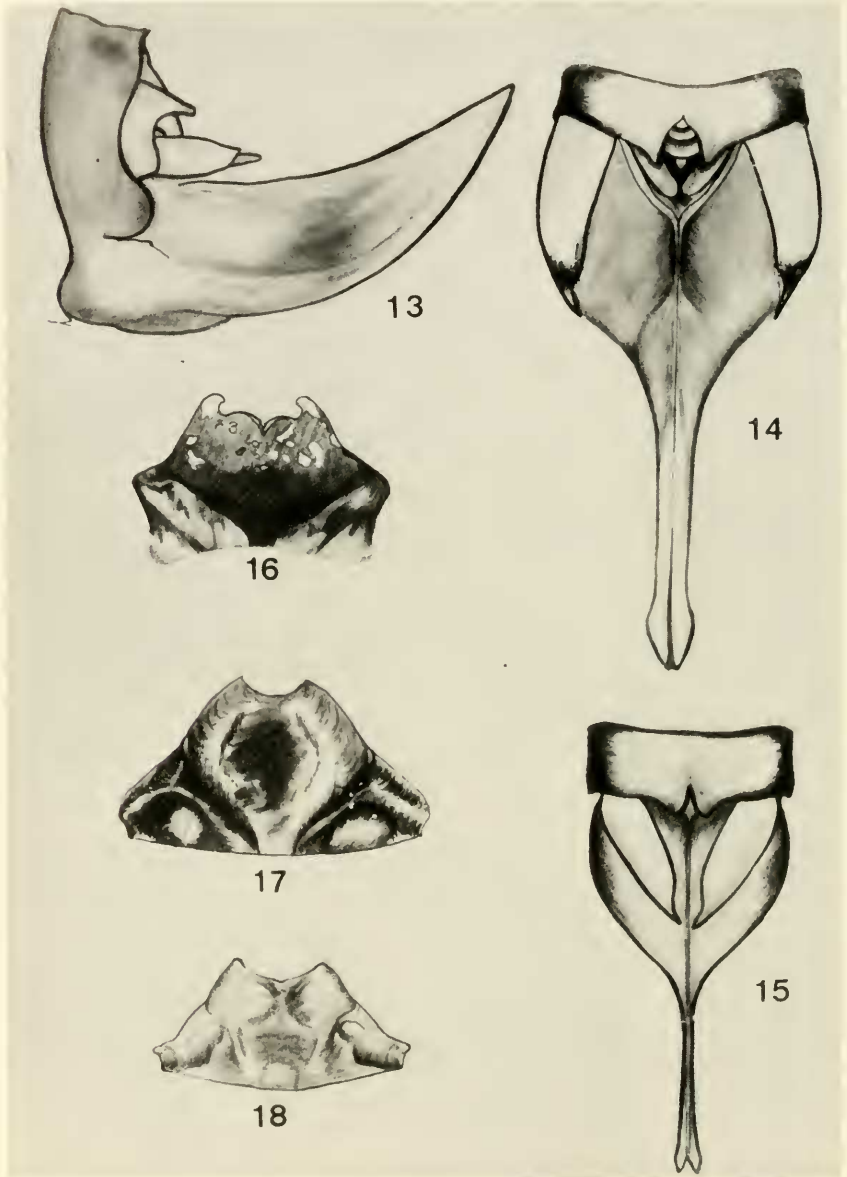
Derivation of name. — This species is named with reference to its geographical distribution in the Atlantic Lowlands of Costa Rica.

Karyotype. —  $2N \text{ } \sigma = 31$ . The largest autosome is submetacentric in configuration and some two to three times larger than the second largest autosome. The second through sixth largest autosomes are intermediate in size while autosomes seven through fifteen are relatively small. All autosomes except the largest are telocentric. The X chromosome is metacentric and similar in size to the largest autosome.

Records. — COSTA RICA: CARTAGO PROVINCE: Juan Vinas, March 1902 (L. Bruner, 1♀, 1♀, last instar, ANSP). HEREDIA PROVINCE: Estrella Valley, Vesta Farm, 13 Sept. 1923 (J. Rehn, 1♀, antepunultimate instar). La Emilia, near Guapiles, 1000 ft. elev., 16 August 1923 (J. Rehn, 2♂♂ 3♀♀; 2♂♂, 1♀ last instars, ANSP). HEREDIA PROVINCE: Finca La Selva on Rio Puerto Viejo, OTS, Arboretum II, River Road, research trail at line 600, 16 July 1973, 14-16 Jan. 1975, (D.C. Rentz, K.R. Brodey, 4♂♂, 7♀♀, including holotype and allotype, numerous nymphs, ANSP).



Figures 8-12. Diagnostic characters in males of *Sphyrometopa atlantica*. Fig. 8, face of holotype; fig. 9, apex of abdomen, dorsal view; fig. 10, right cercus, dorsal view, 10A, internal knob of cercus, ventral view, 10B, apex of hook, ventral view; fig. 11, titillators; fig. 12, subgenital plate, ventral view.



Figures 13-15. Diagnostic characters in females of *Sphyrometopa* species. Fig. 13, 14, *S. atlantica*, lateral and dorsal views ovipositor; fig. 15, *S. femorata*, ovipositor, dorsal view; fig. 16, *S. atlantica*, allotype, subgenital plate; fig. 17, *C. diversus*, holotype, =*S. femorata*, subgenital plate; fig. 18, *S. femorata*, Monte Verde, subgenital plate.

Table 2. Measurements (in mm) of *S. atlantica*

	Length Body	Pronotum Length	Width	Length Exposed Tegmen	Length Hind Femur	Length Ovipositor
<b>Males</b>						
holotype	26.5	8.8	5.1	14.1	23.1	
paratopotype	28.0	9.0	5.1	13.5	22.6	
paratopotype	27.0	9.0	4.7	13.7	22.3	
La Emilia	28.3	8.6	5.1	13.6	22.0	
La Emilia	27.5	8.0	4.8	13.6	21.2	
<b>Females</b>						
allotype	24.0	8.6	4.7	14.0	22.6	10.1
paratopotype	31.0	9.5	5.5	14.1	24.4	10.3
paratopotype	24.0	8.6	5.1	14.2	23.8	9.6
paratopotype	27.0	8.6	4.8	14.0	22.8	10.0
paratopotype	27.0	9.2	5.0	14.1	23.7	9.7
paratopotype	28.0	9.2	5.1	13.3	24.5	9.8
La Emilia	27.0	9.0	5.3	13.0	22.0	7.5
La Emilia	24.5	8.7	5.0	13.0	21.7	9.5
La Emilia	26.5	8.8	5.2	14.1	23.4	9.8
Juan Vinas	29.0	8.9	5.0	13.3	23.2	10.2

Discussion. — *S. atlantica* is locally common along paths and clearings adjacent to primary forest at Finca La Selva. It is dependent on herbaceous vegetation to support the nymphs which apparently seek shelter and feed on such growth. The species is largely absent from grasses and is never found in cleared areas where there is an extensive grass cover. Nymphs are active during the day, their brilliant green color blending them into their environment. At night adults move onto low vegetation. Males sing after dark. The adults are most often associated with habitats vegetated by the following plants: *Selaginella eurynota*, *Diffenbachia seguina*, and *Costus malorticana*. Adults have been seen feeding on the flowers of ginger, *Costus malorticana*.

Frankie et al (1974) provided detailed analysis of the vegetation types found at Finca La Selva along with the climatic and rainfall regimes.

#### ACKNOWLEDGEMENTS

I would like to thank the Organization for Tropical Studies and the Tropical Science Center for providing the research facilities which made our stays in Costa Rica pleasant and productive. I would also like to thank Mr. Kenneth R. Brodey and Stephen T. Harty and members of the 1973-75 Academy of Natural Sciences of Philadelphia "Expeditions for Everyone" fieldtrips for assistance in the field. In addition I would like to thank Dr. David B. Weissman for karyotype information, Dr. Bernd Hauser for sending the type of *Sphyrometopa femorata*, and Michael S. Carter for illustrations.

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